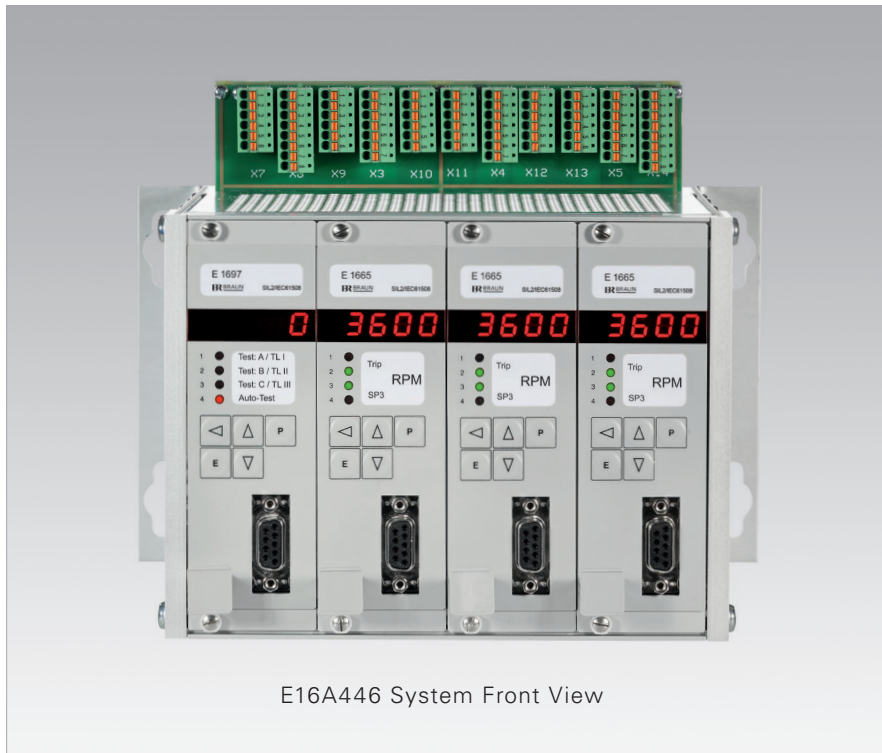


# High Safety TMR Protection Systems for Rotating Equipment with SIL2 requirements Series E16x446



E16A446 System Front View

## E16 – The most secure TMR Protection System worldwide

The BRAUN High Safety Protection System Series E16x446 is SIL2 acc. IEC 61508:2010, API 670 Ed.5 and API 612 Ed.7 compliant. It provides protection against overspeed and detects reverse direction. Also up to six other trip criteria such as emergency stop, boiler protection, etc. can be included in the trip string.

Due to its globally unique and true 2oo3 architecture, the system will tolerate one faulty signal within each trip criterion without trip being released.

The TMR (Triple Modular Redundancy) design ensures highest safety and availability for the monitored machine, i.e. the system will bring the machine into a safe state once it has reached a critical condition.

The E16 Protection System consists of three Monitors E1665 for the evaluation of speed and external trip signals, one Test Generator E1697 and a system backplane; all mounted into a 19" rack.

The E16 Protection System permanently monitors the speed sensors for their correct function. During its complete useful lifetime of 20 years, the system does not require any external proof tests. It is completely maintenance-free and therefore has minimized TCO (Total Cost of Ownership).

All active components (including the trip relays) are directly located on the Monitors and thus can be replaced during operation. The protection system offers in total six 2oo3 Trip Outputs, thereof three for a solenoid trip block and three for other purposes.

### KEY FEATURES

- SIL2 / IEC 61508:2010 compliant
- API 670 Ed.5 compliant
- API 612 Ed.7 compliant
- Total Response Time to Trip < 15 ms
- Useful Lifetime and Proof Test Interval = 20 years
- Triple speed measurement and monitoring by each Monitor
- Variable Overspeed setpoint depending on acceleration
- Direction detection
- Evaluation of external Trip Criteria signals by up to 6 voters per Monitor
- All Trip Outputs formed with safety relay contacts in 2oo3 technique
- Trip Output Monitoring to solenoid with Trip-Lock
- Up to 5 additional speed setpoints in 2oo3 technique
- Sensor signal repeater outputs, free floating, and push/pull
- Automatic test and monitoring of 2oo3 solenoid trip block
- The only protection system worldwide where all relays or other active components are located on the Monitors

### BENEFITS

- Maintenance-free during Lifetime, therefore minimized TCO
- Highest safety at maximum availability due to true 2oo3 architecture for each trip criterion within each Monitor
- Extremely low PFD value (Probability of Failure on Demand), less than 1 % of allowable value for a SIL2 loop
- Replacement of all active components during operation possible (hot swap and highest availability)

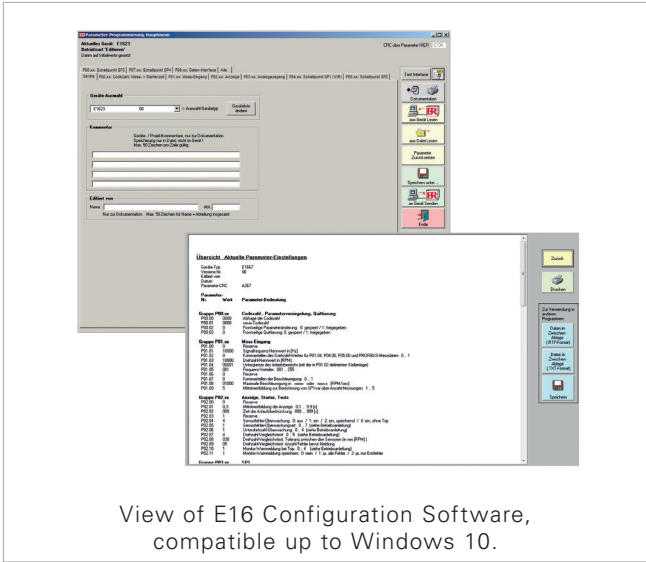
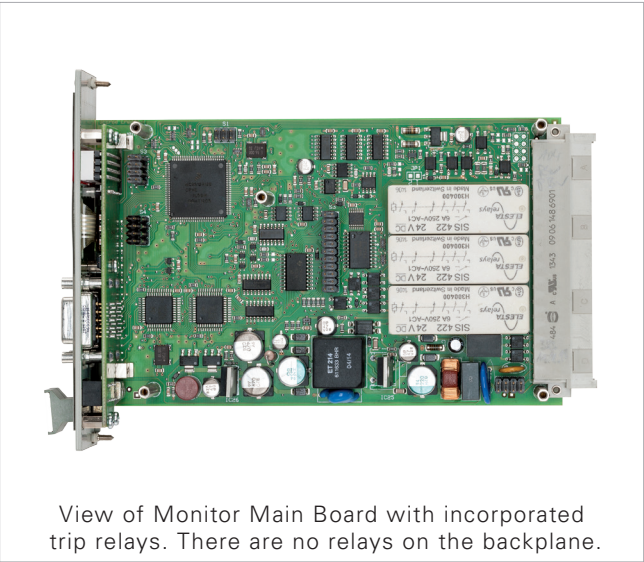
## Specifications of E16x446

<b>Conformity to Standards</b>	<b>Directives</b> 2014/30/EU (EMC Directive) 2014/35/EU (Low Voltage Directive) 2011/65/EU (RoHS Directive) SIL2 acc. IEC 61508:2010, API 670 Ed.5, API 612 Ed.7, EN ISO 13849-1:2008, EN 55011 Class A	<b>Standards</b> EN 61326-1, EN 61326-3-2 EN 61010-1 EN 50581
<b>Power Supply</b>	3x 24 Vdc / 0.5 A, total power consumption < 20 watts (2x 85...265 Vuc on request)	
<b>Speed Signal Inputs</b>	Versions for: BRAUN A5S... Sensors Eddy Current Sensors (EC) Magnetic Pick-Up Sensors (MPU)	
<b>Control Signal Inputs</b>	High Level: +24 Vdc (+18...+48 Vdc) Low Level: 0 Vdc (-20...+3 Vdc) Reference: negative pole of power supply	
<b>Response Time to Trip</b>	Total response time from signal input to Trip Outputs in case of Overspeed Trip or external Trip Criteria: < 15 milliseconds	
<b>Accuracy</b>	+/- 0,1 RPM	
<b>Trip Outputs</b>	All Trip Outputs are 2oo3 voted circuits (2-out-of-3) 2oo3 voting is done by wiring of safety relay contacts (located on Monitors) on system backplane 3 load circuits for solenoid trip block, 3 signal circuits to DCS, PLC or coupling relays Maximum load capacity of load outputs: 3 A / 24 V for DC13 loads Maximum load capacity of signal outputs: 0.1 A / 50 Vdc For inductive type loads spark extinguishing means must be provided	
<b>Alarm Outputs</b>	Maximum load capacity: 0.1 A / 50 Vdc	
<b>Display</b>	Monitors: 5 digits with red LED figures	
<b>Data Interface</b>	Single port PROFIBUS DP, up to 12 Mbit/s RS232 for Parameter Configuration	
<b>Protection Grade</b>	IP 20 for E16A and E16E, IP 65 / NEMA 4 for E16G	
<b>Connectors</b>	Pluggable spring cage connector, Phoenix Combicon FK-MLP1,5/...ST-3,5 (Screw terminal connectors on request)	
<b>Operating Conditions</b>	Ambient temperature: 0...60 °C (32...140 °F) Relative humidity max. 95%, non-condensing	
<b>Safety Data (IEC61508)</b>	PFDavg = $2,51 \cdot 10^{-5}$ at T1 (Proof Check Interval) = 20 years, System Type B; HFT = 1; Architecture 2oo3, Service Time 20 years	
<b>Weight</b>	3,0 kg (E16A), 3,7 kg (E16E), 13,0 kg (E16G)	
<b>Dimensions (W x H x D)</b>	220 x 195 x 222 mm (E16A), 483 x 133 x 218 mm (E16E), 410 x 510 x 270 mm (E16G)	
<b>Optional Accessories</b>	<b>IS-RS232-E16:</b> CD-ROM with Interface Software for OEM, <b>IS-RS232-E16-L2:</b> CD-ROM with Interface Software for Enduser, <b>L3D05:</b> Connection cable between E16 and PC with RS232	

Features of E16 Series

	SIL3	SIL2	PFD Value	Test Interface	Test Generator	Automatic Test of 2oo3 Solenoid by E16	PROFIBUS-Interface
E16x342	•	–	7,71*10 <sup>-5</sup>	•	–	–	Single
E16x352	•	–	7,71*10 <sup>-5</sup>	•	–	–	Dual
E16x346	•	–	8,41*10 <sup>-6</sup>	–	•	•	Single
E16x356	•	–	8,41*10 <sup>-6</sup>	–	•	•	Dual
E16x442	–	•	1,81*10 <sup>-4</sup>	•	–	–	Single
E16x452	–	•	1,81*10 <sup>-4</sup>	•	–	–	Dual
<b>E16x446</b>	–	•	<b>2,51*10<sup>-5</sup></b>	–	•	•	<b>Single</b>
E16x456	–	•	2,51*10 <sup>-5</sup>	–	•	•	Dual

• = Standard, – = Not available



Ordering Key for Systems E16x446.abc

E16x446.a.b.c

**Mechanical Design**

x = A : Bulkhead Mount Version  
x = E : 19" Rack Mount Version 3HE/84TE  
x = G : NEMA 4 Version with front window (Bulkhead Mount)

**Analog Output**

a = 0 : without Analog Output  
a = 1 : 1 Analog Output in each Monitor  
a = 2 : 1 Analog Output certified SIL2 in each Monitor

**Voter**

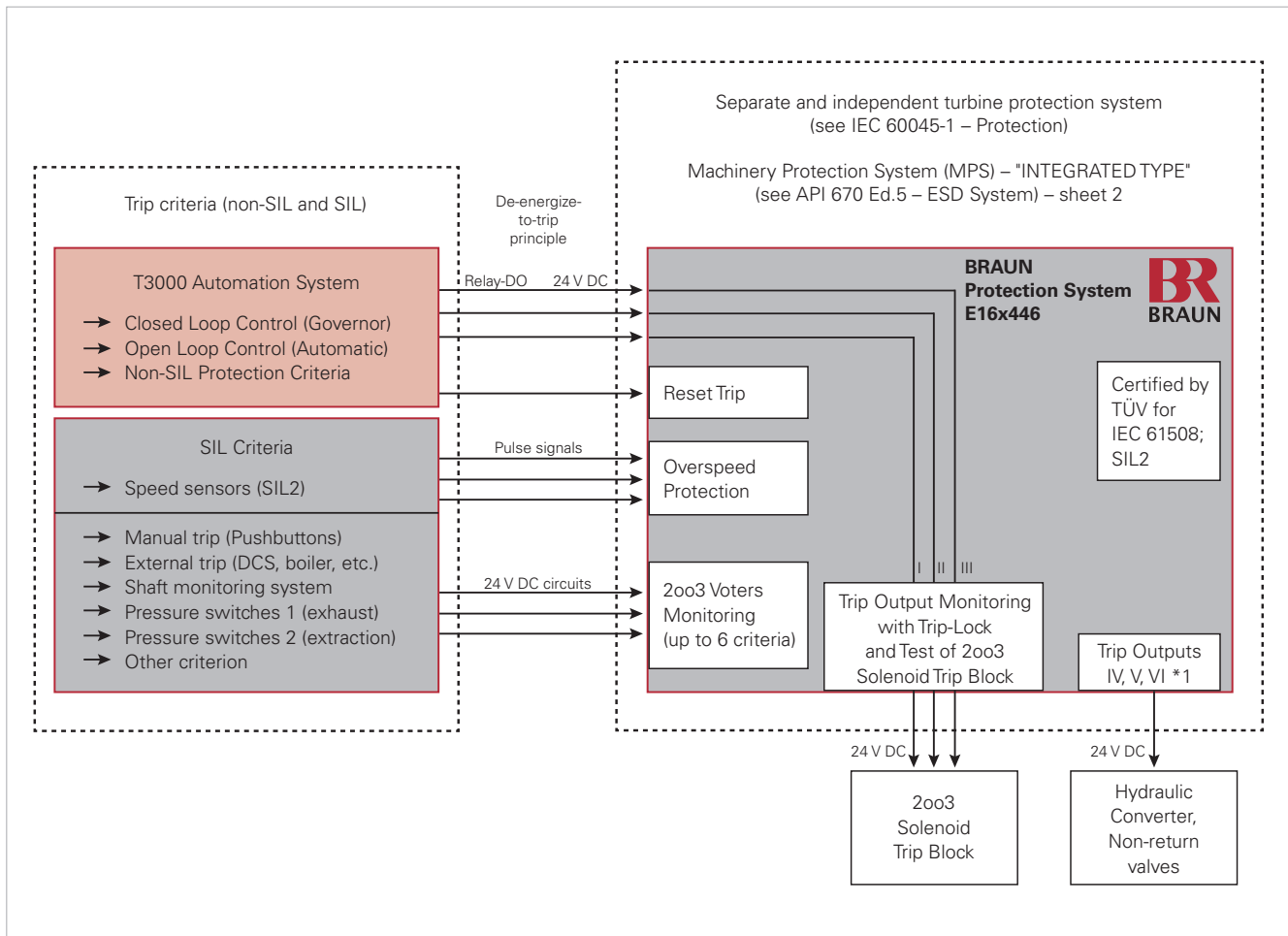
b = 1 : 1 Voter (for 3 signals) in each Monitor for external trip criterion  
b = 2 : 6 Voters (for 18 signals) in each Monitor for external trip criteria

**Speed Signal Inputs**

c = 1 : Speed Signal Inputs and power supply for BRAUN A5S... Sensors  
c = 2 : Speed Signal Inputs and power supply for Eddy Current Sensors (EC)  
c = 3 : Speed Signal Inputs for Magnetic Pick-up Sensors (MPU)

- Examples:**
- E16A446.021 : Bulkhead Mount Version, without Analog Output, with 6 Voters, Speed Signal Inputs for BRAUN A5S... Sensors, 1 PROFIBUS Interface per Monitor
  - E16A446.112 : Bulkhead Mount Version, with Analog Output, with 1 Voter, Speed Signal Inputs for Eddy Current Sensors (EC), 1 PROFIBUS Interface per Monitor
  - E16A446.013 : Bulkhead Mount Version, without Analog Output, with 1 Voter, Speed Signal Inputs for Magnetic Pick-up Sensors (MPU), 1 PROFIBUS Interface per Monitor
  - E16E446.121 : Rack Mount Version, with Analog Output, with 6 Voters, Speed Signal Inputs for BRAUN A5S... Sensors, 1 PROFIBUS Interface per Monitor
  - E16E446.211 : Rack Mount Version, with Analog Output certified SIL2, with 1 Voter, Speed Signal Inputs for BRAUN A5S... Sensors, 1 PROFIBUS Interface per Monitor

## Application Example (by SIEMENS Germany)



## BRAUN – Speed Monitoring and Protection Systems for Rotating Equipment

BRAUN Industrial Electronics develops, produces and sells an array of "Rotating Equipment" protection systems for use in industrial applications worldwide with the focus on overspeed protection. These systems comply with the highest standards of safety and availability.

As a globally leading technology provider with over 50 years of experience, BRAUN has been continually meeting and mastering the challenges associated with protecting the facilities of companies within the power generation, oil, gas, and chemical industries. Our protection systems are installed in more than 100 countries around the world and are mainly used in safety-critical applications with rotating parts.

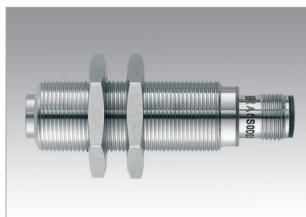
For our OEM customers, BRAUN is both a solution oriented systems provider and a reliable partner.

Our solutions comprise a variety of products for the detection and monitoring of speed and related parameters.

Always matching the requirement. Always the perfect solution for safety and availability.



**PROTECTION SYSTEMS**



**SPEED SENSORS**



**TACHOMETERS**



**PORTABLE TACHOMETERS**

